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SPACE GATEWAY SUPPORT (SGS) **SGS-27 13 23.00 99 (April 2006)**

Preparing Activity: SGS-DE **Superseding SGS-16127J (February 2005)**

SGS GUIDE SPECIFICATIONS

References are NOT in Agreement with UMRL dated 01 April 2006

Revised throughout - changes not indicated by CHG tags
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DIVISION 27 - COMMUNICATIONS

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COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

04/06

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SECTION 27 13 23.00 99

COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
04/06

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NOTE: This guide specification covers the requirements for single made (SM), multimode (MM) or mixed optical fiber cable for outside plant telecommunications..

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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PART 1 GENERAL

1.1 SCOPE

This specification is for the requirements of a single made (SM), multimode (MM) or mixed optical fiber cable for outside plant telecommunications system applications at Kennedy Space Center (KSC) facilities.

1.2 DESCRIPTION

The SM, MK or mixed optical fiber communications cable covered by this specification shall be suitable for:

a. Installation in the existing underground ducts and manholes
b. Direct Burial
c. The transmission of telephone signals, wideband analog signals, and high-speed data signals at KSC.

The optical fiber cable shall contain 12, 24, or 144 optical filters.

1.3 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below (or current updates/revisions)form a part of this section to the extent referenced:

ASTM INTERNATIONAL (ASTM)

ASTM C 338	Standard Test Methods For Softening Point of Glass
ASTM D 1248	Standard Specification for Polyethylene Plastics molding and Extrusion Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA RS-455	EIA Standard Fiber Optic Test Procedures FOTP Series
EIA-359-A	EIA Standard Codes For Color Identification and Coding

1.4 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident

Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy, Air Force, and NASA projects.

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The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fiber Optic Cable
Interface Connection
Termination Equipment
Splice Boxes
Control Cabinets

PART 2 PRODUCTS

2.1 FIBER OPTIC CABLE DESIGN

2.1.1 Cable Length

The cable shall be manufactured continuous with no factor/splices in the fiber. The cable length per reel and number/type fiber car cable will be as specified on the purchasing order.

2.1.2 Materials and Construction

Materials used within a given cable shall be compatible with all other materials used in the same cable when such materials come into intimate contact . All cable components used shall have no adverse affects on optical transmission or on the mechanical integrity characteristics of the fiber placed in the cable. All materials used shall be non-toxic, non-hydrogen generation, non-corrosive, and shall present no dermal hazards. The minimum required components applied to fiber optic cable construction are the central core member, color-coded optical fiber, color-coded loose buffer tube with gel-filling, gel-filling around loose. tube, inner jacket , pulling strength members, and outer jacket. Variations in sequence and construction of components will be considered. Submit Manufacturer's Catalog Data for the following items:

Fiber Optic Cable
Interface Connection
Termination Equipment
Splice Boxes
Control Cabinets

2.1.2.1 Central Core Member

A central core member shall be included to serve as a cable core foundation to reduce strain on the fibers but not to serve as pulling strength member. The material of the central core member shall be non-metallic.

2.1.2.2 Optical Fibers

Multimedia fiber, shall be contained in the cable.

Multimode (MM) Fiber: The multimode fiber shall be the graded index optical glass. The core diameter of the fiber shall to 50 ± 3 um. The cladding diameter shall be 125 ± 2 um. The core-cladding offset shall be less than 3 um. The minimum tensile strength of the fiber after primary protective coating shall to greater than 1O0.000 psi. The softening point of the clad material of the optical fiber shall be 163U° C - 50 ° C per ASTM C 338. If the optical fiber does nor meet the core diameter or softening point requirement, the Fusion Splice Compatibility Test shall be applied (Ref: Paragraph 9).

2.1.2.3 Fiber Primary Protective Coating

The optical fiber shall be coated with a suitable material to preserve the intrinsic high tensile strength of the glass fiber. The outside diameter of the coated optical fiber shall be 250 ± 15 um. The coated material shall be mechanically removable by commercially available stripping tools without damaging the optical fibers when the removal is desired.

2.1.2.4 Optical Filter Color Coating

The primary protective coated fibers (MM Fibers) shall be coated with code color for individual fiber identification. The maximum outside diameter of color fiber shall be less than 300 um.

2.1.2.5 Loose Buffering Tube

The color case coated fibers shall be surrounded with a loose buffering tube for protection an external mechanical and environmental influences. The interior of the tube shall be filled with a suitable gel-filling compound to prevent water migration. The loose Buffering tube shall be color coded for the tube identification. The material of the buffering tube shall be PVC, mylar, nylon, or a functionally equivalent material.

2.1.2.6 Colorants

The color concentrates or inks used to color cue the optical fibers and the loose buffer tube shall not be susceptible to migration and chemical reaction wit- the gel filling compound and the gel filling compound cleaner solvents.

2.1.2.7 Number of Fibers Per Tube Per Cable

Three types of cable, a 12-fiber cable, a 24-fiber cable and a 144-fiber cable, shall be identified on the design plans. Each shall contain MultiMode (MM) fibers in bundles within loose buffer tubes. MM fibers shall not be mixed in the same loose buffer tube. The configuration will be specified on the purchase order.

12-Fiber Cable: The fiber cable shall contain 12 MM fibers with a cable core configuration comprised of 2 loose buffer tubes each containing a 6 fiber bundle.

24-Fiber Cable: The fiber cable shall contain 24 MM SI fibers with a cable core configuration comprised of 4 loose buffer tubes each containing a 6 fiber bundle.

144-Fiber Cable: The fiber cable shall contain 144 MM fibers with a cable core configuration comprised of 12 to 24 loose buffer tubes each containing a 6 or 12 fiber bundle as required.

Fiber and Buffer Coloring: The fibers of each buffer tube call be color coded as follows: Blue (HL), Orange (O), Green (GR), Brown (BN), Gray (G), White (W), Red (R), Black (BK), Yellow (Y), Violet (V), Pink, and Aqua. The loose buffer tubes shall follow the same colors as shown for the fibers and shall be laved in order as shown. Pink and aqua shall be used for the buffer tubes containing single-mode fibers and pink only for the 36 fiber cable. The purchase order will specify colors for buffers containing MM and SM fibers for cable configurations different than already specified in this specification. The colors for both the fibers and the buffer tubes shall be in accordance with EIA-359-A. The munsell notations for pink shall be within 1R-4R 6.5-8.5/10 greater than 10 and .for aqua shall be within 2BG-8BG 6.5-8.5/6-10.

2.1.2.8 Inner Jacket

The buffer tubes shall be located concentrically around the cable central core member and covered with polyethylene inner jacket. The polyethylene inner jacket shall be high- or medium-density polyethylene in accordance with ASTM D 1248, Class C, Type II or III. The space between the buffer tubes and inner jacket shall be filled with a gel compound to prevent air, moisture, or water intrusion in the inner jacket.

2.1.2.9 Filling Compound

The inner jacket interior and loose tube buffer cavity shall contain a gel-type filling compound. The filling compound shall be of suitable viscosity so that it will protect the optical fibers against the ingress of water and/or soluble chemicals and shall not flow at the temperature of up to 80° C. The gel-filling compound shall be electrically non-conducting, inert gel-type, waterproof compound, non-toxic, with no dermal hazards, and compatible chemically and mechanically with all cable components and associated splice hardware materials with which it may make contact. The gel-filling compound shall be removable, as required, using commercially available products under field-type conditions.

2.1.2.10 Pulling Strength Member

Aramid-type material shall be used as pulling strength members in the cable between the inner and the outer jacket to provide pulling strength (at least 600 pounds) for the cable during installation.

2.1.2.11 Cable Outer Jacket

Black high- or medium-density, high-molecular-weight, polyethylene materials (in accordance with ASTM D 1248, Class C, Type II or III) shall be applied longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. The outer jacket shall be smooth,

concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. The overall outside cable diameter shall depend on field installation or purchase order requirement. The thickness of the outer jacket shall be no less than 1.4 mm.

2.2 IDENTIFICATION

2.2.1 Individual Optical Fiber

The individual optical fiber shall be easily and positively identified from the loose buffer tube color code and the optical fiber primary coating color code.

2.2.2 Cable Outer Jacket Marking

The outer jacket shall bear the manufacturer's name, year of manufacture, and length marker. The length marking shall employ continuous four-digit numbering in meters such as:

Manufacturer's Name - Year
XXXX m

The markings shall be repeated clearly and distinguishably on every meter on the cable outer jacket. The marking ink shall be fully compatible with the jacket material, non-smearing, non-water-soluble, abrasion-resistant, and durable enough to withstand field handling during placement and subsequent operations.

2.2.3 Optical Performance

The fiber optical cable shall comply with the following performance requirements:

2.2.3.1 Multimode Fibers in the Cable

Attenuation: The optical attenuation of each optical fiber in the cable (reeled) shall be no greater than 1.0 dB/km at 1300±50 nm and 1550±50 run optical spectrum windows. The attenuation shall be measured on completed cable reel length and normalized linearly to 1 km. The measurement method shall be in accordance with EIA RS-455, Series FOTP-46, FOTP-53, or FOTP-61 at central wavelength 1300 rim and 1550 nm nominal. The attenuation uniformity shall be no greater than 0.2 dB at 1300 nm using OTDR test per EIA RS-455, Series FOTP-59.

Multimode Bandwidth: The bandwidth at -3 dB optical power of each optical fiber in the cable (reeled) shall be a bandwidth length product, gamma = 1, equal or greater than 1 GHz-km at 1300±50 run optical spectrum window. The bandwidth measurement shall be in accordance with EIA RS-455, Series FOTP-30 (frequency domain) or FOTP-51 (time domain) at central wavelength 1300 nm nominal.

Numerical Aperture: The numerical aperture of each optical fiber shall be 0.20±0.02 at 1300 nm optical spectrum window. The method of numerical aperture measurement shall be in accordance with EIA RS-455, Series FOTP-47 at central wavelength 1300 rim nominal. If this requirement is not met, the fusion splice compatibility test shall be applied (reference paragraph 9).

Multimode Chromatic Dispersion: The chromatic dispersion of each multimode optical fiber shall be zero dispersion wavelength point at 1310±13 run

range with the zero dispersion slope no greater than 0.101 ps/(nm2•km) per EIA RS-455, Series FOTP-168 test method.

Mode Field Diameter: The mode field diameter at 1300 nm optical spectrum window shall be no less than 8.7 um and no greater than 9.8 um. The measurement method shall be in accordance with EIA RS-455, Series FOTP-164, FOTP-165, FOTP-166, or FOTP-174 and Petermann II definition at central wavelength 1300 nm nominal. If this requirement is not met, the Fusion Splice Compatibility Test shall be applied (Ref. Paragraph 9)

Cut-Off Wavelength: The cut-off wavelength of each optical fiber in cable shall be less than 1260 nm. The measurement method shall be in accordance with EIA RS-455, Series FOTP-170.

2.2.4 Mechanical Performance

For mechanical performance requirements (Paragraphs 6.2..x), the magnitude of the attenuation change shall be 0.0 dB for 90% of the test fibers with 10% of the fibers not measuring a change greater than 0.1 dB for each test in Paragraph 6.1 through 6.2.8.

Minimum Bend Radius: The cable shall be able to withstand bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with a maximum tensile load applied (during installation), without damage to cable components or degradation of the optical fiber performance at room temperature.

Tensile Strength: The fiber optical cable shall withstand a pull force of at least 2669 newtons (600 lbs.) to be applied to the pulling strength member during the installation, and a tensile load of at least 500 newtons (112 lbs.) during operations without incurring any damage or detriment to fiber optical cable and optical performance. The tensile strength test shall be per EIA RS-455, Series FOTP-33A.

Flexing of Bending Cycle: The fiber optical cable shall withstand at least 25 bending cycles at minimum bend radius without damaging the fiber optic cable components or degrading optical performance. The cyclic flexing test shall be per EIA RS-455, Series FOTP-104.

Crush Resistance: The minimum. crush resistance of the fiber optical cable shall be 650 newtons/cm maintained for five minutes without damaging the cable components or degrading optical performance when measured five minutes after load release. The crush resistance test shall be per EIA RS-455, Series FOTP-41A.

Impact Resistance: The fiber optical cable shall be capable of withstanding 25 impacts at 5 newton-meters force without damage to cable components or degradation of optical performance. The impact resistance test shall be per EIA RS-455, Series FOTP-25A.

Gel-Filling Compound Drip Test: The optical cable shall be tested for the ability of the gel-filling compound in the interior of the inner jacket and loose buffer tube to resist flow at the temperature range of -40 to +80° C in accordance with EIA RS-455, Series FOTP-81.

Fluid Penetration: The optical cable shall be capable of preventing the entry and axial migration of pressurized water when subjected to fluid penetration testing in accordance with EIA RS-455, Series FOTP-92.

PART 3 EXECUTION

3.1 INSTALLATION

Install wires, cables, and wiring connectors in accordance with recognized industry installation practices.

Coordinate with other work, including electrical raceway and equipment installation work, as necessary to interface installation of cables with other work.

-- End of Section --